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Lathyrus aphaca L.: the distribution, habitats and remarks on the status of the species in Poland

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Abstract

Lathyrus aphaca, which is in Poland considered to be an ephemerophyte recorded mainly in the north-west and the south-west, has lately been observed in arable fields in the south of the country. Recent and historical data on the distribution of the taxon in Poland are presented. Original relevés conducted in arable fields in Poland are analysed and compared to those from the Czech Republic, Germany and Slovenia. The current status of *L. aphaca* in the Polish flora is discussed.

Keywords: weeds, Caucalidion alliance, epoecophyte, ephemerophyte, Poland

Introduction

Lathyrus aphaca is a species of Mediterranean-Irano-Turanian origin. At present, the species mostly occurs in Western and Southern Europe, southern part of Central Europe, northern parts of Africa as well as in South-Western and Central Asia [1-4]. Reports on the introduction of *L. aphaca* to North America are also available [5,6].

According to Rostański and Sowa [7], *Lathyrus aphaca* is an ephemerophyte in Poland, that is an alien species introduced transiently and not established permanently. The same status was later proposed for the species by Mirek et al. [8,9]. However, field studies carried out by us in 2007-2009 suggest that *L. aphaca* may be established in some regions of Poland.

Description of the species

Lathyrus aphaca L. [= *Lathyrus segetum* Lam., *Aphaca vulgaris* C. Presl., *Orobus aphaca* (L.) Döll.; English: yellow pea, yellow-flowered pea or yellow vetchling; Polish name proposed by us: groszek bezlistkowy] is an annual plant species with scrambling or trailing stems up to 100 cm long. Mature leaves of the plant have no leaflets. They are only composed of ovate-hastate stripules (0.6-5 cm × 0.5-4 cm) and tendrils. Stems bear some solitary flowers. The peduncle linking the flower to the stem is 20-50 mm long. Flowers are 7-13 mm long. Calyx teeth are 2-3 times as long as the tube. The corolla is bright yellow, sulphur or cream. Legumes are glabrous, straight or incurved, 2-3.5 cm long and 0.3-0.8 cm wide, with 6-8 seeds. Seeds are ellipsoid to globose, usually flattish with a glossy, smooth, dark purple-brown to black surface, sometimes spotted to marbled. Chromosome number: 2n = 14 [2,4,10,11].

A number of varieties were distinguished based on the differences in the flower size, the corolla colour and the number of flowers per peduncle observed in specimens of the species. The *Lathyrus aphaca* complex reaches its maximum variability in Anatolia [2].

Habitats of *Lathyrus aphaca*

Within its natural range, *Lathyrus aphaca* is recorded in natural habitats (mainly rocky limestone slopes, stream banks, and plant communities representing the formation described as phrygana in the eastern regions of the Mediterranean area), in semi-natural meadows and glades, as well as in arable fields, on fallow lands and roadsides [2,3,12]. Within the anthropogenic part of its range in Europe, *L. aphaca* was observed in a different type of habitats, e.g. in the vegetation of forest edges representing the Trifolio-Geranietea sanguinei class, on dry lawns, transport route edges (especially along railway lines), in orchards, arable fields and fallows [4,13].

Phytosociologically, *Lathyrus aphaca* is a diagnostic species of segetal communities in cereals and legume-grain mixtures (preferably winter cultures) and winter rape in warm areas of the temperate to submeridionale zones of the Euro-Siberian region representing the Caucalidion lappulae alliance [14].

Material and methods

The list of localities of *Lathyrus aphaca* in Poland is based on herbarium allegates, literature data and our field studies. The herbarium material collected by us is deposited in the herbarium of the Institute of Botany, Jagiellonian University

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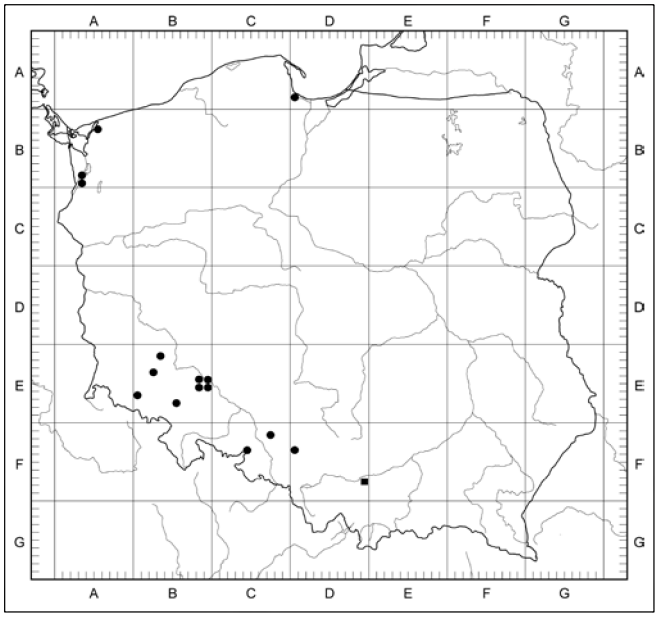

Fig. 1 A distribution map of *Lathyrus aphaca* L. in Poland; black circle – locality at which the species was recorded as an ephemerophyte, black square – locality where the species is an established component of the flora.

in Kraków (KRA).

Research on the occurrence of *Lathyrus aphaca* in plant communities was conducted in 2007-2009 at the same sites, i.e. in three arable fields in the southern part of Kraków. The Braun-Blanquet method was used in phytosociological investigations [15]. A total of eight phytosociological relevés were performed. The area of each relevé was the same (2 m × 10 m). Their location was determined using a GPS receiver (the WGS84 coordinate system).

The relevés with *Lathyrus aphaca* from Kraków were compared with those from three other countries: 12 relevés from the Czech Republic [16], one relévе from Germany [17] and 17 relevés from Slovenia [18]. The SYN-TAX 2000 software package [19] was used for numerical analysis.

Results

The occurrence of *Lathyrus aphaca* in Poland

The list below comprises all the localities of *Lathyrus aphaca* recorded in Poland to date. Their locations are given using the ATPOL grid square system of 10-km cartogram units [20]. The habitat (if specified in the source), the author's name and the publication/collection date are given for all the records. The standardised abbreviation of the hosting herbarium is added for herbarium data.

ZACHODNIOPOMORSKIE VOIVODESHIP. **AB25:** Kamień Pomorski, no habitat data; according to Holzfuss [21], Weicker collected *Lathyrus aphaca* at this locality in 1912 (but the herbarium material is not available in any Polish herbarium). **AB83:** Szczecin – Gdańska Str., rubble heaps; Holzfuss [21] collected the plant at this locality in 1936 (but the herbarium material is not available in any Polish herbarium). Szczecin – Gdańska Str., rubble heaps; according to Scheuermann [22], the plant was repeatedly brought into this locality with cereals. **AB93:** Siadło Dolne near Szczecin, no habitat data; Holzfuss [21] collected the plant at this locality in 1935 (but the herbarium material is not available in any Polish herbarium). POMORSKIE VOIVODESHIP. **DA80:** Gdańsk – Westerplatte, N-Port and Wisłoujście, squares and tipping sites for ballast soil in the port; according to Abromeit et al. [23], Bail collected the plant at this locality in 1879 (but the herbarium material is not available in any Polish herbarium). DOLNOŚLĄSKIE VOIVODESHIP. **BE13:** Buczynka near Lubin, arable field (*Secale cereale* culture); Schube [24]. **BE32:** Lipce near Legnica, no habitat data; Schube [24]. **BE48:** Wrocław – city port, rubbish tips near a mill; according to Meyer [25], the plant was brought into this locality with barley imported from Southern Europe and Morocco. **BE48:** Wrocław, tracks (exotic fruit handling site) and near a covered market; Meyer [26]. **BE49:** Wrocław – the yard by the covered market in Tęczowa Str. ("Siebenhufener Strasse") used for storage of fruit from Southern Europe; Schalow [27] collected the plant at this locality in 1931 (but the herbarium material is not available in any Polish herbarium). **BE49:** Wrocław – between the Zacisze and Kowale estates, no habitat data; according to Schalow [28], Becker collected the plant at this locality in 1932 (but the herbarium material is not available in any Polish herbarium). **BE58:** Wrocław – western freight station, rubbish tips and tracks; according to Meyer [29], the plant was brought into this locality with cereal and citrus fruit. **BE59:** Wrocław – Tarnogaj, no habitat data; according to Schube [30], Behnsch collected the plant at this locality in 1900 (the herbarium material is deposited in WRSL). **BE60:** Jelenia Góra – Skowronków, no habitat data; according to Schube [30,31] Fiek collected the plant at this locality in 1900 (but the herbarium material is not available in any Polish herbarium). **BE75:** Świdnica – by the road towards Wałbrzych; according to Schube [32], Wildner collected the plant at this locality in 1904 (the herbarium material is deposited in WRSL). OPOLSKIE VOIVODESHIP. **CF17:** Strzelce Opolskie, no habitat data; Michalak [33] collected the plant at this locality in 1973 (but the herbarium material is not available in any Polish herbarium). **CF34:** Głogówek, a rubbish tip near a brickyard; Szotkowski [34] collected the plant at this locality in 1974 (but the herbarium material is not available in any Polish herbarium). ŚLĄSKIE VOIVODESHIP. **DF30:** Gliwice – a river port, on rubbish tips near warehouses with packaged cargo; Szotkowski [35] collected the plant at this locality in 1967 (the herbarium material is deposited in KTU). MAŁOPOLSKIE VOIVODESHIP. **DF 79:** Kraków – Kobierzyn, the plant was observed as a weed in cereal cultures by A. Nobis and M. Nobis in 2007, 2008, 2009 and 2010 (the herbarium material is deposited in KRA).

Lathyrus aphaca has been rarely recorded in Poland. Until 2006, it was reported from a total of twenty localities in seventeen 10-km ATPOL grid squares. The plant was recorded a few times at some of the localities. It was mostly observed in north-western and south-western Poland (Fig. 1). Over 80% of the reports on the plant's occurrence in Poland date from before World War II. Published data show that it was recorded only in the Śląskie and Opolskie voivodeships after World War II. *L. aphaca* has been recorded on rubble heaps and waste dumps in river ports. It has also been observed at tracks (at cargo handling sites) and near covered markets where it was brought in with cereals imported from Southern Europe and hay used to protect citrus fruit from frost and mechanical damage. Single localities in arable fields and on ballast soil tips have also been reported. No habitat data are often available for many of its historical localities.

Tab. 1 Segetal communities with *Lathyrus aphaca* in Kraków.

Succesive No.	1	2	3	4	5	6	7	8	Constancy
Date	22.06.2007	22.06.2007	12.07.2007	15.07.2009	15.07.2009	15.07.2009	15.07.2009	15.07.2009	
Latitude (N)	50°00'18.3"	50°00'11.7"	49°59'52.8"	49°59'54.1"	50°00'18.5"	50°00'18.6"	50°00'14.6"	50°00'09.5"	
Longitude (E)	19°52'42.8"	19°52'39.2"	19°52'19.0"	19°52'19.1"	19°52'42.0"	19°52'45.3"	19°52'38.9"	19°52'39.8"	
Area of the releve (m^2)	20	20	20	20	20	20	20	20	
Cover C (%)	40	50	60	60	60	70	50	70	
Cover of cultivated plant (%)	30	40	20	40	50	40	30	50	
Cover of of weeds (%)	30	30	50	40	20	40	30	40	
Maximum height of cultivated plant (cm)	90	110	90	80	80	90	100	100	
Average height of cultivated plant (cm)	80	80	80	60	70	70	90	90	
Maximum height of weeds (cm)	100	110	110	120	130	60	70	120	
Average height of weeds (cm)	30	40	30	30	30	20	20	20	
Number of species in relevé	25	26	26	29	27	29	26	31	
Cultivated plants:									
Triticum aestivum	3	.	1	.	+	+	3	4	IV
Avena sativa	.	3	2	.	4	3	.	.	III
Hordeum vulgare	.	.	2	3	.	+	.	.	II
Ch. Caucalidion lappulae:									
Lathyrus aphaca	1	1	+	1	+	+	1	1	V
Avena fatua	+	1	2	.	2	.	+	2	IV
Euphorbia exigua	.	1	1	+	+	.	2	1	IV
Valerianella dentata	+	.	.	2	.	+	.	1	III
Geranium disectum	.	+	.	+	.	1	.	.	II
Lathyrus tuberosus	.	.	.	.	.	+	+	+	II
Sherardia arvensis	.	1	.	.	.	.	.	+	II
Valerianella rimosa	.	.	.	+	.	+	.	.	II
Ch. Centauretalia cyani:									
Centaurea cyanus	1	+	+	1	2	.	+	+	V
Apera spica-venti	1	1	.	3	1	.	1	2	IV
Aphanes arvensis	2	+	.	+	+	.	1	+	IV
Bromus secalinus	2	.	.	.	2	.	1	2	III
Odontites verna	+	.	.	+	.	.	.	+	II
Papaver rhoeas	1	.	.	.	+	.	+	.	II
Ch. Polygono-Chenopodietalia:									
Setaria pumilla	+	+	3	+	.	1	+	1	V
Veronica persica	.	+	1	+	1	2	1	1	V
Lamium purpureum	.	1	.	.	1	2	.	+	III
Oxalis stricta	.	+	+	+	.	.	.	.	II
Sonchus asper	.	.	+	.	.	+	.	+	II
Chenopodium album	.	.	.	.	+	+	.	.	II
Capsella bursa-pastoris	.	.	.	.	+	+	.	.	II
Euphorbia helioscopia	.	.	.	.	+	+	.	.	II
Ch. Stellarietea mediae:									
Myosotis arvensis	1	+	1	1	1	1	1	1	V
Polygonum aviculare	1	1	+	1	1	1	1	1	V
Viola arvensis	+	1	+	1	1	1	1	1	V
Anagallis arvensis	.	1	1	1	+	+	1	+	V
Lapsana communis	+	.	1	+	+	.	2	1	IV
Matricaria maritima ssp. *inodora*	.	2	+	2	.	1	2	2	IV
Fallopia convolvulus	1	.	.	.	+	2	+	+	IV
Stellaria media	1	+	.	+	.	.	.	.	II
Galeopsis tetrahit	+	.	.	+	.	.	.	+	II
Ch. Artemisietea:									
Galium aparine	1	+	+	2	2	2	1	1	V
Equisetum arvense	+	2	2	1	.	+	1	+	V
Cirsium arvense	+	2	.	+	+	+	.	.	IV
Convolvulus arvensis	.	.	+	.	.	1	2	1	III
Galeopsis pubescens	.	.	.	.	.	+	+	+	II
Others:									

Tab. 1 *(continued)*

Succesive No.	1	2	3	4	5	6	7	8	
Veronica arvensis	+	+	+	1	1	1	+	.	V
Polygonum persicaria	.	+	1	+	.	.	+	.	III
Phragmites australis	.	1	+	+	.	.	.	.	II
Mentha arvensis	+	.	1	.	.	.	.	+	II
Medicago lupulina	.	.	+	.	.	.	+	+	II
Arenaria serpylifolia	+	.	.	1	.	.	.	.	II
Phleum pratense	.	1	.	.	+	.	.	1	II

SPORADIC: **Ch. Centauretalia cyani:** *Anthemis arvensis* 1; *Scleranthus annuus* 4(1); *Vicia tetrasperma* 5. **Ch. Polygono-Chenopodietalia:** *Echinochloa crus-gali* 3(2); *Galinsoga ciliata* 6. **Ch. Stellarietea mediae:** *Amaranthus chlorostachys* 6; *Thlaspi arvense* 6; *Vicia hirsuta* 5. **Ch. Artemisietea:** *Artemisia vulgaris* 5. **Others:** *Daucus carota* 3; *Sedum maximum* 3; *Trifolium campestre* 3.

The field studies conducted by us suggest that *Lathyrus aphaca* is locally established in Poland. It has been observed in arable fields in the southern part of Kraków in the last few years. The species has been reported in crops of wheat, oat and barely, and in their mixtures. Specimens of *L. aphaca* were recorded both on the margins and in central parts in each of these fields. They were not, however, distributed uniformly but formed small agglomerations, mainly at field margins. The abundance of its populations in individual fields ranged from over fifty to ca. 200 specimens. The plant was not recorded outside these fields, that is in nearby meadows and wastelands, on baulks or roadsides, despite special investigations. Although the size of patches with *L. aphaca* documented by us was relatively small, the relevés were quite rich in species (Tab. 1). From 25 to 31 species were recorded in a single relevé. The coverage of *L. aphaca* in the patches ranged between 1% and 5%. As relevés were repeated in the same arable fields in successive years and the fields are located close together, the species composition is similar (Fig. 2). Apart from *L. aphaca*, four other species were observed in all relevés: *Myosotis arvensis*, *Polygonum aviculare*, *Viola arvensis* and *Galium aparine*, while the highest constancy was also observed for seven other taxa (i.e. *Anagallis arvensis*, *Avena fatua*, *Centaurea cyanus*, *Equisetum arvense*, *Setaria pumila*, *Veronica arvensis*, *Veronica persica*). As there is an evident contribution of a number of weeds attached to fertile alkaline soils (i.e. *Avena fatua*, *Euphorbia exigua*, *Geranium dissectum*, *Lathyrus tuberosus*, *Sherardia arvensis*, *Valerianella dentata*, *Valerianella rimosa*) in our relevés, all of the

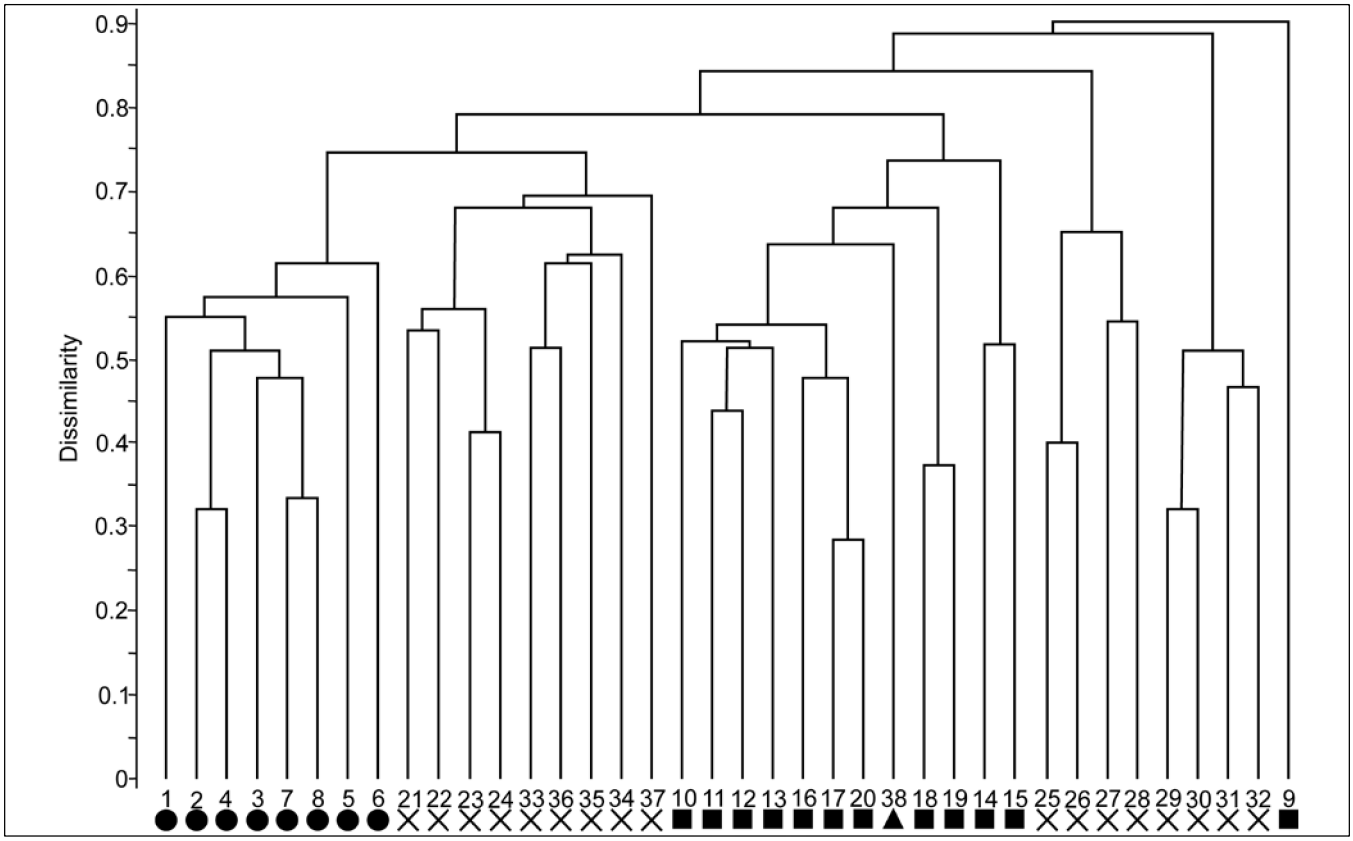

Fig. 2 A dendrogram based on the relevés from Poland (black circle, Nos. 1-8), Czech Republic (black square, Nos. 9-20), Slovenia (black cross, Nos. 21-37) and Germany (black triangle, No. 38; Jaccard coeficient, UPGMA clustering method).

Tab. 2 A synthetic comparison (constancy in percentages and I-V class values) of relevés with *Lathyrus aphaca* from Poland, the Czech Republic and Slovenia.

	Poland		Czech Republic		Slovenia	
Total No. of relevés	8		12		17	
Mean No. of species in relevé	27		35		23	
Ch. Caucalidion lappulae:						
Lathyrus aphaca	100%	V$^{+\cdot1}$	100%	V$^{+\cdot2}$	100%	V$^{+\cdot1}$
Avena fatua	75%	IV$^{+\cdot2}$	58%	III$^{+\cdot1}$	.	.
Euphorbia exigua	75%	IV$^{+\cdot2}$	58%	III$^{+\cdot1}$	.	.
Valerianella dentata	50%	III$^{+\cdot2}$	.	.	12%	I^{+}
Geranium dissectum	37%	II$^{+\cdot1}$	17%	I$^{r\cdot+}$	12%	I^{r}
Lathyrus tuberosus	37%	II^{+}	75%	IV$^{r\cdot2}$	.	.
Sherardia arvensis	25%	II$^{+\cdot1}$	42%	III$^{r\cdot+}$	6%	I^{+}
Valerianella rimosa	25%	II^{+}	.	.	24%	II$^{+\cdot1}$
Legousia speculum-veneris	.	.	.	.	64%	IV$^{+\cdot4}$
Agrostemma githago	.	.	.	.	29%	II$^{+\cdot3}$
Ranunculus arvensis	.	.	83%	V$^{+\cdot2}$	41%	III$^{+\cdot2}$
Consolida regalis	.	.	75%	IV$^{r\cdot3}$	18%	I$^{+\cdot3}$
Adonis aestivalis	.	.	67%	IV$^{+\cdot2}$	.	.
Galium spurium	.	.	67%	IV$^{+\cdot1}$	.	.
Silene noctiflora	.	.	50%	III^{+}	.	.
Fumaria vaillantii	.	.	25%	II$^{r\cdot+}$	6%	I^{+}
Kickxia spuria	.	.	25%	II$^{r\cdot+}$	.	.
Conringia orientalis	.	.	25%	II$^{r\cdot+}$	.	.
Lamium amplexicaule	.	.	33%	II$^{r\cdot+}$	.	.
Euphorbia falcata	.	.	25%	II$^{r\cdot+}$	.	.
Galium tricornutum	.	.	8%	I^{1}	24%	II$^{+\cdot2}$
Bifora radians	.	.	8%	I^{2}	12%	I$^{+\cdot2}$
Ch. Centauretalia cyani:						
Centaurea cyanus	87%	V$^{+\cdot2}$	.	.	29%	II$^{+\cdot2}$
Apera spica-venti	75%	IV$^{1\cdot3}$	.	.	41%	III$^{+\cdot1}$
Aphanes arvensis	75%	IV$^{+\cdot2}$	.	.	53%	III$^{+\cdot2}$
Bromus secalinus	50%	III$^{1\cdot2}$	.	.	.	.
Odontites verna	37%	II^{+}	.	.	.	.
Papaver rhoeas	37%	II$^{+\cdot1}$	58%	III$^{r\cdot1}$	71%	IV$^{+\cdot1}$
Vicia tetrasperma	12%	I^{+}	8%	I^{+}	29%	II^{+}
Anthemis arvensis	12%	I^{+}	.	.	53%	III$^{+\cdot1}$
Vicia angustifolia	.	.	75%	IV$^{r\cdot+}$	35%	II$^{+\cdot2}$
Lithospermum arvense	.	.	33%	II^{+}	18%	I^{+}
Vicia sativa	.	.	.	.	24%	II^{+}
Ch. Polygono-Chenopodietalia:						
Setaria pumila	87%	V$^{+\cdot3}$	.	.	.	.
Veronica persica	87%	V$^{+\cdot2}$	92%	V$^{r\cdot2}$	53%	III$^{r\cdot+}$
Lamium purpureum	50%	III$^{+\cdot2}$	17%	I^{r}	18%	I^{+}
Oxalis fontana	37%	II^{+}	.	.	24%	II^{+}
Sonchus asper	37%	II^{+}	42%	III$^{+\cdot1}$	24%	II^{+}
Chenopodium album	25%	II^{+}	58%	III$^{r\cdot+}$	18%	I^{+}
Capsella bursa-pastoris	25%	II^{+}	17%	I^{+}	41%	IV$^{+\cdot3}$
Euphorbia helioscopia	25%	II^{+}	.	.	12%	I^{+}
Echinochloa crus-galli	12%	I^{2}	.	.	6%	I^{1}
Sonchus arvensis	.	.	58%	III$^{+\cdot3}$	6%	I^{1}
Atriplex patulum	.	.	42%	III$^{r\cdot+}$	.	.
Sonchus oleraceus	.	.	25%	II$^{r\cdot+}$	.	.
Ch. Stellarietea mediae:						
Myosotis arvensis	100%	V$^{+\cdot1}$	67%	IV$^{r\cdot+}$	53%	III$^{+\cdot1}$
Polygonum aviculare	100%	V$^{+\cdot1}$	67%	IV$^{r\cdot1}$	24%	II$^{+\cdot1}$
Viola arvensis	100%	V$^{+\cdot1}$	83%	V$^{r\cdot+}$	53%	III$^{+\cdot2}$

relevés represent plant communities of the Caucalidion alliance. In the patches documented with relevés, the highest constancy is recorded for not only plants typical of communities of arable fields representing the Centauretalia cyani order, the Polygono-Chenopodietalia order or generally the Stellarietea mediae class but also ruderal species typical of the Artemisietea class commonly occurring in arable fields. Bryophytes were not observed at any of the patches documented with relevés.

Czech relevés were conducted in wheat, rye, barley and oat cultures to document the contribution of *Lathyrus aphaca* in segetal communities [16]. In Slovenia, relevés where *Lathyrus aphaca* is a wheat weed dominate; however, relevés were also carried out in barley cultures [18].

The highest contribution of species belonging to the Caucalidion alliance is recorded in the relevés from the Czech Republic. A constancy of over 50% was observed for *Lathyrus aphaca* as well as for the following species representing the Caucalidion alliance: *Adonis aestivalis*, *Avena fatua*, *Consolida regalis*, *Euphorbia exigua*, *Galium spurium*, *Lathyrus tuberosus* and *Ranunculus arvensis* [16]. A greater number of species of the Caucalidion alliance also occurs in relevés from Slovenia; however, *Legousia speculum-veneris* was the only species recorded in over 50% of the relevés [18]. Eight species of Caucalidion alliance, i.e. *Avena fatua*, *Euphoria exigua*, *Kickxia elatine*, *Kickxia spuria*, *Sherardia arvensis*, *Silene noctiflora* and *Stachys annua*, were recorded in the only available relevé with *L. aphaca* from Germany [17]. Unlike the relevés from Poland, the presence of meadow species of the Molinio-Arrhenatheretea class and Arrhenatheretalia order is observed in relevés from both the Czech Republic and Slovenia (Tab. 2).

An analysis carried out using the SYN-TAX 2000 software package [19] – UPGMA clustering method, 1/0 (presence/absence) data, Jaccard coefficient – shows that the relevés from Poland (Nos. 1-8) and relevés from Slovenia performed in arable fields (in cereal cultures) in the central and south-eastern part of the country (Nos. 21-24, 33-37) are most similar to each other. One relevé from Germany (No. 38) and 11 relevés conducted in the Czech Republic (Nos. 10-20) constitute the next distinguishable group. The similarity coefficient between this group and the group of all relevés from Poland and Slovenia is only slightly lower than that between the relevés from Poland and the inland part of Slovenia. The highest dissimilarity is observed for one relevé from the Czech Republic (No. 9). The relevé was conducted in a plant community patch with a high contribution of meadow species and trees. Moreover, relevés from Slovenia performed in areas near the Mediterranean coast are grouped separately. Some of them were conducted in cereal cultures (Nos. 25-28) while the remaining ones in nurseries (Nos. 29-32).

Discussion

In Western and Central Europe, *Lathyrys aphaca* occurs mostly in regions characterised by a comparatively warm and dry vegetation period as well as the presence of the alkaline substrate rich in calcium. As such climatic and soil conditions are also recorded in some regions of Poland, especially in the highlands in the south (Wyżyna Lubelska Upland and Wyżyna Małopolska Upland), it seems surprising that the occurrence of *L. aphaca* has not been reported from these areas.

In Poland, *Lathyrus aphaca* has been classified as an ephemerophyte. However, our research shows that it is actually

Tab. 2 *(continued)*

	Poland		Czech Republic		Slovenia	
Anagallis arvensis	87%	V^{+-1}	58%	III^{+}	35%	II^{+-1}
Lapsana communis	75%	IV^{+-2}	67%	IV^{+}	.	.
Matricaria maritima ssp. *inodora*	75%	IV^{+-2}	58%	III^{r-+}	.	.
Fallopia convolvulus	62%	IV^{+-2}	75%	IV^{r-+}	29%	II^{+-1}
Stellaria media	37%	II^{+-1}	67%	IV^{r-+}	24%	II^{r-+}
Galeopsis tetrahit	37%	II^{+}	8%	I^{r}	.	.
Thlaspi arvense	12%	I^{+}	25%	II^{r-+}	.	.
Vicia hirsuta	12%	I^{+}	8%	I^{1}	29%	II^{+-1}
Sinapis arvensis	.	.	83%	V^{+-1}	29%	II^{+-3}
Lactuca seriola	.	.	17%	I^{r-+}	6%	I^{+}
Raphanus raphanistrum	.	.	.	.	24%	II^{r-+}
Ch. Artemisietea:						
Galium aparine	100%	V^{+-2}	67%	IV^{+}	53%	III^{+-2}
Equisetum arvense	87%	V^{+-2}	25%	II^{+-1}	35%	II^{+-1}
Cirsium arvense	62%	IV^{+-2}	75%	IV^{r-1}	59%	III^{+-1}
Convolvulus arvensis	50%	III^{+-2}	83%	V^{r-3}	88%	V^{+-1}
Galeopsis pubescens	37%	II^{+}	.	.	.	.
Meliliotus officinalis	.	.	17%	I^{+}	6%	I^{+}
Ch. Arrhenatheretalia elatioris:						
Daucus carota	12%	I^{+}	83%	V^{r-1}	.	.
Taraxacum officinale agg.	.	.	58%	III^{r-1}	18%	I^{+}
Achillea millefolium s. lato	.	.	17%	I^{r-1}	18%	I^{+}
Plantago lanceolata	.	.	8%	I^{+}	6%	I^{+}
Pastinaca sativa	.	.	8%	I^{+}	6%	I^{+}
Dactylis glomerata	.	.	8%	I^{2}	6%	I^{+}
Arrhenatherum elatius	.	.	8%	I^{3}	12%	I^{+}
Stellaria graminea	.	.	8%	I^{+}	6%	I^{+}
Ch. Molinio-Arrhenatheretea:						
Phleum pratense	37	II^{+-1}	.	.	6%	I^{1}
Trifolium repens	.	.	42%	III^{r-1}	12%	I^{+}
Ranunculus repens	.	.	17%	I^{r-1}	24%	II^{+-1}
Prunella vulgaris	.	.	17%	I^{r-1}	6%	I^{+}
Potentilla reptans	.	.	17%	I^{r}	6%	I^{+}
Poa trivialis	.	.	8%	I^{2}	12%	I^{+}
Lysimachia nummularia	.	.	8%	I^{+}	6%	I^{+}
Plantago maior	.	.	8%	I^{+}	6%	I^{2}
Poa annua	.	.	8%	I^{+}	24%	II^{+}
Rumex acetosa	.	.	8%	I^{1}	12%	I^{+}
Others:						
Veronica arvensis	87%	V^{+-1}	.	.	29%	II^{+-1}
Polygonum persicaria	62%	III^{+-1}	.	.	24%	II^{+-2}
Phragmites australis	37%	II^{+-1}	.	.	.	.
Mentha arvensis	37%	II^{+-1}	8%	I^{+}	41%	III^{+-1}
Medicago lupulina	37%	II^{+}	67%	IV^{r-1}	18%	I^{+}
Arenaria serpyllifolia	25%	II^{+-1}	.	.	29%	II^{+-1}
Trifolium campestre	12%	I^{+}	8%	I^{+}	.	.
Stachys palustris	.	.	42%	III^{r-+}	12%	I^{+}
Elymus repens	.	.	25%	II^{r-1}	53%	III^{+-2}
Erysimum cheiranthoides	.	.	25%	II^{r-+}	.	.
Vicia sepium	.	.	17%	!$^{+}$	12%	I^{r}
Senecio vulgaris	.	.	8%	I^{r}	24%	II^{r}
Polygonum lapathifolium s. lato	.	.	8%	I^{r}	6%	I^{+}
Polygonum sp.	.	.	8%	I^{r}	6%	I^{r}
Calystegia sepium	.	.	.	.	29%	II^{+}
Falcaria vulgaris	.	.	25%	II^{r-+}	.	.
Campanula rapunculoides	.	.	25%	II^{+-1}	.	.

established in the Kraków area. It is observed here each year even though cultivated plants change in successive years. As in other European countries, it also occurs in Kraków in its typical habitat, i.e. in arable fields, as a component in communities of field weeds resembling the Caucalidion alliance. While *L. aphaca* has the status of an archeophyte in the neighbouring countries such as Germany or the Czech Republic [36,37], it should be treated as a local epoecophyte in the flora of Poland.

It should be stressed that a drop in the number of *Lathyrus aphaca* localities has been observed in some central European countries for many years as the weed flora is greatly influenced by intensively developing technology. Therefore, the species is included on national red lists. *L. aphaca* is considered to be threatened in Germany or even strongly threatened in some parts of it [38]. It is a critically threatened species in the Czech Republic [39], threatened in Slovakia (EN according to the IUCN criteria) [40], and near threatened in Hungary (NT according to the IUCN criteria) [41].

Recently, arable fields in the southern part of Kraków have been extensively managed and *Lathyrus aphaca* does not seem to be threatened by growing technology. However, the localities can soon be destroyed by the progressive development of the city, and especially by numerous building investments. A discontinuation of cultivations can also pose a threat to the existence of the species.

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Tab. 2 *(continued)*

	Poland		Czech Republic		Slovenia	
Prunus domestica	.	.	25%	II^{+}	.	.
Betula pendula	.	.	25%	II^{r}	.	.

Species noted with the lowest degree of constancy, in relevé from only one country. POLAND. **Ch. Centauretalia cyani:** *Scleranthus annuus* 12%, I^{1}. **Ch. Polygono-Chenopodietalia:** *Galinsoga ciliata* 12%, I^{+}. **Ch. Stellarietea mediae:** *Amaranthus chlorostachys* 12%, I^{+}. **Ch. Artemisietea:** *Artemisia vulgaris* 12%, I^{+}. **Others:** *Sedum maximum* 12%, I^{+}. CZECH REPUBLIC. **Ch. Caucalidion lappulae:** *Bupleurum rotundifolium* 8%, I^{r}; *Caucalis platycarpos* 8%, I^{2}; *Chaenorhinum minus* 17%, I^{r}; *Euphorbia platyphyllos* 17%, I^{+}; *Kickxia elatine* 8%, I^{+}; *Lathyrus hirsutus* 8%, I^{1}; *Neslia paniculata* 17%, I^{+}; *Stachys annua* 17%, I^{+}; *Thymelaea passerina* 8%, I^{r}; *Veronica polita* 8%, I^{+}. **Ch. Polygono-Chenopodietalia:** *Chenopodium polyspermum* 8%, I^{+}; *Setaria viridis* 17%, I^{r+}. **Ch. Artemisietea:** *Cichorium intybus* 17%, I^{+}; *Tanacetum vulgare* 8%, I^{+}; *Torilis japonica* 8%, I^{1}. **Ch. Arrhenatheretalia elatioris:** *Crepis biennis* 17%, I^{r-1}; *Galium mollugo* 8%, I^{+}; *Knautia arvensis* s. lato 8%, I^{+}; *Leontodon hispidus* 17%, I^{r+}; *Lotus corniculatus* 8%, I^{+}; *Trisetum flavescens* 8%, I^{1}. **Ch. Molinio-Arrhenatheretea:** *Agrostis gigantea* 8%, I^{1}; *Festuca pratensis* 8%, I^{2}; *Lolium perenne* 8%, I^{r}. **Others:** *Allium sativum* 8%, I^{r}; *Allium scorodoprasum* 8%, I^{+}; *Allium vineale* 8%, I^{+}; *Brachythecium rutabulum* 8%, I^{1}; *Cerasus avium* 8%, I^{3}; *Cerasus vulgaris* 8%, I^{1}; *Chenopodium ficifolium* 8%, I^{r}; *Coronilla varia* 8%, I^{1}; *Crataegus monogyna* 17%, I^{r+}; *Erodium cicutarium* 8%, I^{+}; *Euphorbia virgata* 8%, I^{+}; *Fragaria viridis* 8%, I^{1}; *Galium verum* 8%, I^{1}; *Geum urbanum* 8%, I^{+}; *Hypericum perforatum* 8%, I^{+}; *Juglans regia* 8%, I^{r}; *Lophocolea bidentata* 8%, I^{1}; *Salvia verticillata* 8%, I^{+}; *Scleropodium purum* 8%, I^{+}; *Malus sylvestris* 8%, I^{1}; *Pimpinella saxifraga* 8%, I^{+}; *Plagiomnium affine* 8%, I^{2}; *Plantago media* 8%, I^{1}; *Poa compressa* 8%, I^{+}; *Quercus robur* 8%, I^{+}; *Rubus caesius* 17%, I^{+}; *Veronica chamaedrys* 8%, I^{2}; *Veronica hederifolia* s. lato 17%, I^{+2}. SLOVENIA. **Ch. Caucalidion lappulae:** *Adonis flammea* 6%, I^{1}; *Ajuga chamaepitys* 6%, I^{1}; *Myagrum perfoliatum* 6%, I^{+}; *Vaccaria hispanica* 6%, I^{1}; *Valerianella locusta* 18%, I^{+}; *Vicia peregrina* 6%, I^{+}. **Ch. Centauretalia cyani:** *Lolium temulentum* 12%, I^{+1}. **Ch. Polygono-Chenopodietalia:** *Galinsoga parviflora* 12%, I^{+}. **Ch. Stellarietea mediae:** *Lathyrus nissolia* 6%, I^{2}; *Lolium rigidum* 6%, I^{+}; *Stachys arvensis* 12%, I^{r+}; *Vicia villosa* 12%, I^{+1}. **Ch. Artemisietea:** *Armoracia rusticana* 6%, I^{+}; *Rumex obtusifolius* 12%, I^{+}. **Ch. Arrhenatheretalia elatioris:** *Crepis capillaris* 6%, I^{+}; *Lolium multiflorum* 18%, I^{+}. **Ch. Molinio-Arrhenatheretea:** *Holcus lanatus* 6%, I^{+}; *Rorippa sylvestris* 12%, I^{+}; *Rumex crispus* 12%, I^{+}; *Trifolium pratense* 18%, I^{+1}; *Vicia cracca* 6%, I^{+}. **Others:** *Anchusa azurea* 6%, I^{+}; *Avena barbata* 12%, I^{+2}; *Centaurea* sp. 6%, I^{+}; *Centaurium pulchellum* 6%, I^{+}; *Cerastium brachypetalum* 18%, I^{+}; *Cerastium glomeratum* 18%, I^{+}; *Conyza canadensis* 12%, I^{+}; *Cynodon dactylon* 12%, I$^{1-2}$; *Erigeron annuus* 6%, I^{+}; *Eupatorium cannabinum* 6%, I^{+}; *Galeopsis ladanum* 6%, I^{1}; *Glechoma hederacea* 6%, I^{+}; *Lathyrus* sp. 6%, I^{+}; *Medicago sativa* 6%, I^{1}; *Melampyrum arvense* 6%, I^{+}; *Melandrium album* 6%, I^{+}; *Mentha longifolia* 6%, I^{+}; *Picris echioides* 6%, I^{+}; *Poa* sp. 6%, I^{+}; *Prunella vulgaris* 6%, I^{+}; *Rhinanthus* sp. 12%, I^{+}; *Riphastrum rugosum* 6%, I^{+}; *Rumex* sp. 6%, I^{+}; *Sedum sexangulare* 6%, I^{+}; *Symphytum officinale* 6%, I^{+}; *Tussilago farfara* 6%, I^{+}; *Vicia grandiflora* 6%, I^{+}; *Vicia pannonica* 6%, I^{+}; *Viola tricolor* 12%, I^{r}.

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